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ENVIRONMENT PROGRAMME
MEDITERRANEAN ACTION PLAN

UNEP

02 June 2021
Original: English

Fifteenth Meeting of SPA/BD Focal Points

Videoconference, 23-25 June 2021

Agenda item 5: Conservation of Species and Habitats

Interpretation Manual of Marine Habitat Types in the Mediterranean Sea

UNEP/MAP
SPA/RAC - Tunis, 2021

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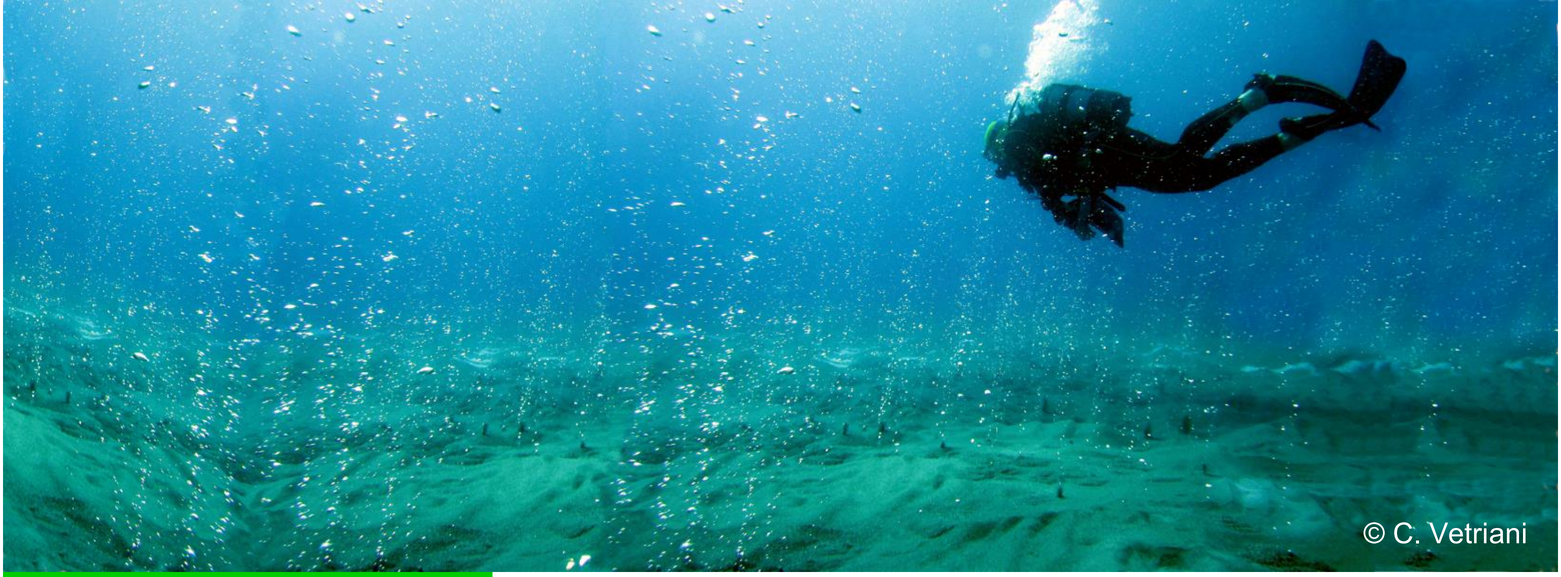

Facies with *Tritia* spp. and nematodes in hydrothermal vents

Reference codes for identification:

- **BARCELONA CONVENTION: MB5.539**
- **EUNIS 2019: MB5537**
- **EUNIS 2007: A5.285**
- **EC: 1180**
- **CORINE: 11.22 (partim)**

LOCATION OF THE HABITAT

Zone	Infralittoral (to circalittoral)
Nature of the substratum	Soft (sand, also with seagrass), hard (rock)
Depth range	0.5 m to 30+ m
Position	Coastal
Hydrodynamic conditions	Weak
Salinity	Variable
Temperature	13 °C to 35+ °C
Suitability for monitoring	Yes, but not applied

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INFRALITTORAL

MB5.5 Infralittoral sand

MB5.53 Fine sand in sheltered waters

MB5.539 Facies with *Tritia* spp. and nematodes in hydrothermal vents

Description of the habitat

Hydrothermalism in the Mediterranean Sea results from the collision of the African and European tectonic plates. High heat flows in the resulting volcanic arcs and back-arc extensional areas set-up hydrothermal convection systems in shallow coastal waters. Phase separation is a common feature. Vent water compositions range from reduced salinity with only slightly reduced pH, to a salinity as high as 53 with a pH as low as 2, and with enrichments in sulphide and heavy metals. Vent water temperature is usually higher than the ambient seawater. The major component of the vented gas is carbon dioxide, with lesser amounts of sulphur dioxide, hydrogen sulphide, methane and hydrogen. White or coloured algo-minero-bacterial mats are found around the vent fluid outflows. Minerals in these mats include elemental sulphur, silicates, arsenic, mercury and iron compounds. The point where the fluid escapes may be encircled by a sediment coloured orange by the precipitation of arsenic sulphides and yellow due to elemental sulphur. The area at a short distance from the vent centre, or above underlying brine seeps, is often covered with a whitish mat due to sulphur bacteria and silicate, with zones coloured brown-green by diatoms and cyanobacteria. Whitish filamentous bacterial mats attach to rocks surrounding the vent outlets, and a white layer of bacteria and of mineral precipitates may cover seagrass leaves.

Geographic distribution

Shallow-water hydrothermal vents are widespread in the Mediterranean Sea, owing to the active volcanism of the area. Major systems are known along the volcanic arc in the Southern Tyrrhenian Sea (Aeolian Islands, Cape Palinuro, Phlegrean area) and along the Hellenic Volcanic Arc in the Aegean Sea (Methana Peninsula and the islands of Milos, Santorini and Kos).

Associated habitats

The facies with *Tritia* spp. and nematodes in hydrothermal vents is found in shallow water fine sands, but hydrothermal vents may also occur in seagrass meadows, amidst rocks at various depths, and within caves, differently affecting the local biotic assemblages.

Related reference habitats

The facies with *Tritia* spp. and nematodes in hydrothermal vents is typically nested in the habitat 'Fine sand in sheltered waters' (MB5.53). Shallow-water hydrothermal vents, however, may also occur close to or within the 'Association with indigenous marine angiosperms' (MB5.521), the 'Algal-dominated infralittoral rock' (MB1.51), the 'Continental shelf rock' (MC1.52), the 'Semi-dark caves and overhangs' (MC1.53), the 'Caves and ducts in total darkness' (ME1.52), and other habitats on the continental shelf.

Possible confusion

The facies with *Tritia* species and nematodes in hydrothermal vents is easily recognised by the fluid column that rise from the seafloor, and the characteristic bacterial mats on the surrounding substrata.

Typical species and associated communities

Characteristic species, which are able to thrive in these extreme conditions, can be found among prokaryotes (bacteria and archaea). They are involved in the transformation of inorganic compounds released from the vent emissions into biomass, and are therefore at the basis of the hydrothermal system food web. Archaea include extremophilic (thermophilic and/or acidophilic) species, and especially hyperthermophilic Crenarchaeota. Iron bacteria and large sulphur bacteria (e.g., *Beggiatoa* sp. and *Achromatium volutans*) are common. Species of the gastropod *Tritia* (*T. corniculum*, *T. cuvierii*, *T. incrassata*, *T. neritea*) may abound in systems with overlying fine sands. *T. neritea*, for instance, may occur in very high densities (>200$\cdot m^{-2}$), tolerating elevated salinity, temperature, and sulphide concentrations up to 1 mM. It often clusters around the periphery of gas vents, using suitable rock or seagrass as substrata for egg deposition. The species is also found on the bacterial mats, where it ingests large quantities of bacteria and diatoms but also scavenges on animals killed by the extreme conditions of the brine seeps and by the rising gases. Scavenging nematodes of the genera *Oncholaimus* and *Daptonema*, tolerant of low pH and sulphides, are common around the periphery of the venting area. Sulphide-tolerant annelids such as *Capitella* sp. and *Limnodriloides pierantonii* may also occur. A number of macrobenthic species (e.g. the amphipod *Ampelisca ledoyeri*, the mud shrimp *Necallianassa truncata*, and the lancelet *Branchiostoma lanceolatum*) demonstrate some preference to areas surrounding vents. Fish are attracted by the upward flow of water generated by the gas plumes or flares and may station themselves over the bubble columns. Hydrothermal vents with high sulphide occurring in seagrass meadows exclude *Posidonia oceanica*, thus favouring the more tolerant *Cymodocea nodosa*. Enrichment in silica may favour the growth of the sponge *Geodia cydonium.* In areas where vents contain only carbon dioxide and no toxic substances, the presence of calcifying species is reduced, and the macrobenthic assemblages are dominated by fleshy algae and smaller-bodied, generalist invertebrates.

Conservation interest and ecological role

Hydrothermal vents host novel species of prokaryotes (44% of the archaeal lineages isolated from Mediterranean hydrothermal vents represent novel phyla), and many benthic species show local adaptations and possible sibling species. Five recently described species of *Amphiglena* (Polychaeta, Sabellidae) are exclusive of four Mediterranean vent systems. A high epifaunal diversity surrounds some of the vents. Endosymbiosis between bacteria and nematodes has recently been discovered at some sites. Biological productivity is enhanced at oxic/anoxic interfaces in vent sites, and may support a flourishing community of consumers.

Economic importance

Shallow-water hydrothermal vent systems and their associated biota offer provision and information services to humans. Microorganisms living there represent an almost untapped resource for enzymes with improved catalytic properties and biomolecules potentially valuable in biotechnology. Vents are a source of recreation (visitation by scuba diving tourists), but are above all important for scientific research. The first description of shallow-water hydrothermal vents in the Mediterranean Sea dates back to at least 1860, when Dumas called 'bollitore' (= boiler) the gaseous manifestations in the Caldera of Panarea (Aeolian Islands, Italy). This notwithstanding, they have been much less investigated than their deep-sea counterparts, discovered more than a century later. While deep-sea hydrothermal vents give rise to a distinct ecosystem, fuelled by chemolithotrophy and methanotrophy, those on the continental shelf induce change in otherwise ‘normal’ ecosystems. They emit warm water, carbon dioxide, toxic chemicals, nutrients and reduced compounds that mimic climate and human impacts on marine ecosystems. These vents are natural laboratories where the responses of populations, communities and whole ecosystems to such stressors can be studied – something that cannot be replicated in mesocosms. Natural CO_2 vents are useful as a proxy to investigate the ecological effects of ocean acidification, one of the expected consequences of the greenhouse effect and global change. The monetary value of this habitat has not been assessed yet.

Vulnerability and potential threats

Commercial (tourism, harvesting of genetic resources, mineral exploitation, fishing) and scientific (sampling, instrument deployment, experimental setup) activities can potentially impact morphological, geochemical and biological dynamics of vent ecosystems.

Protection and management

Considering the importance and the peculiarity of the habitat of shallow-water hydrothermal vents, management measures should be recommended to guarantee their conservation. Deep-sea vent ecosystems are protected in many countries, such as Canada (Endeavour Hydrothermal Vents Marine Protected Area), Mexico (Guaymas Basin and Eastern Pacific Rise Hydrothermal Vents Sanctuary), Portugal (Azores Hydrothermal Vent Marine Protected Areas), and United States (Mariana Trench National Monument), but no similar initiatives exist to date for Mediterranean shallow-water vent ecosystems. The planned establishment of a marine protected area in the Aeolian Islands (Italian Law 979/82, art. 31) may help conserve the shallow-water hydrothermal vents existing there. Specific locations of the Hellenic Volcanic Arc are designated for protection, but implementation is yet pending (https://mpatlas.org/countries/GRC/map).

Suitability of the habitat for monitoring

Easy recognition of vents, by the presence of bubble plumes and white mats on the seabed, should facilitate their monitoring. Little is known about the persistence of hydrothermal vent structures and the stability of the biotic assemblages at Mediterranean sites. Information on their dynamics, present status, and resilience after disturbances is virtually lacking.

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Tritia neritea gathering
(© A.J. Southward)

White mat of bacteria and
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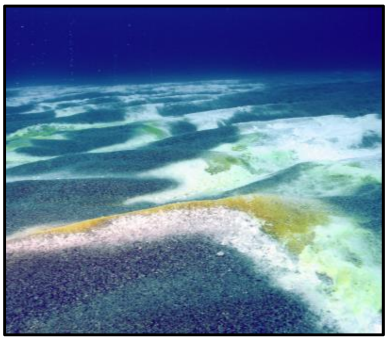

White mat with patches of
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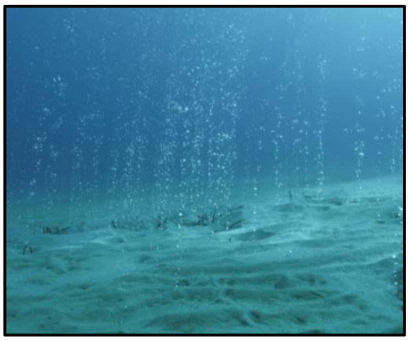

Venting on sand
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Venting within seagrass
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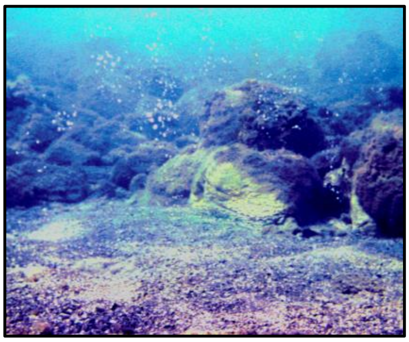

Venting amidst rocks
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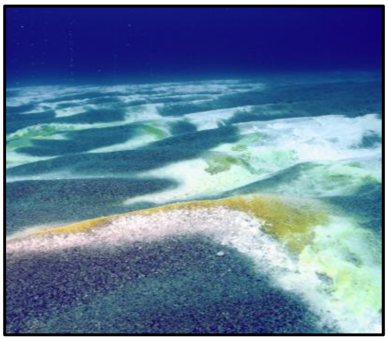

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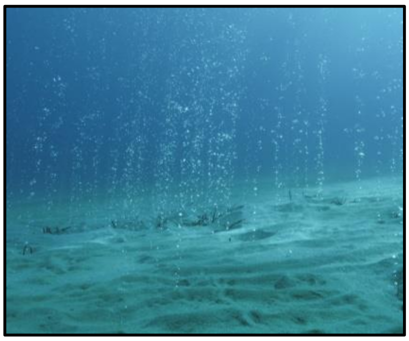

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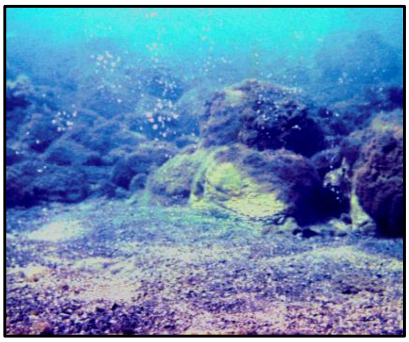

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